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**SOME OBSERVATIONS ON THE OPISTHOBRANCH FAUNA FROM THE FUSARO LAKE, A BRACKISH-WATER LAGOON NEAR NAPLES. (\*\*\*)**

KEY WORD: Opisthobranchs, Lagoon, Mediterranean Sea

**Summary**

The opisthobranch fauna of Fusaro, a coastal lagoon near Naples (Tyrrhenian Sea), is studied and a comparison with previous data is made. Results show that although the lagoon is heavily polluted, diversity of opisthobranch species is quite high.

**Riassunto**

È stata studiata la fauna ad Opistobranchi del Lago Fusaro, una laguna costiera vicino Napoli, ed è stata effettuata una comparazione con i dati precedenti. I risultati mostrano che, nonostante l'elevato inquinamento della laguna, la diversità specifica è piuttosto elevata.

**Introduction**

The Fusaro, a coastal lagoon near Naples, had been previously sampled by SCHMEKEL (1968) in her work about the Opisthobranchia from the Gulf of Naples (see CATTANEO-VIETTI & CHEMELLO, 1991). Several samplings were made in order to widen the knowledge about the opisthocenose of the lagoon, and also to make a comparison with previous works.

The Fusaro lagoon is situated on the Western side of the Gulf of Naples, in the area called «Campi Flegrei» (Fig. 1), and separated from the Tyrrhenian Sea by a barrier formed by a coastal dune. Geologically, the lagoon originates from a secondary volcanic process.

The lagoon is near 100 ha at the surface, with a water volume of about 3 millions m<sup>3</sup> and a medium depth of 2.5 m (LECCESE & SPEZIALE, 1967). It opens into the Tyrrhenian Sea through three little channels, which penetrate the coastal dune (Fig. 2). The Southernmost one, called Foce Romana, is 750 m long; in the centre, Foce di mezza Chiaia, is the shortest, only 400 m long. Foce Nuova, to the North, is 600 m long. The medium depth of these channels is about 1.5 m, but in some areas of the Foce Romana and specially of the Foce Nuova the bottom is closer to the surface, thus becoming an obstacle for water circulation.

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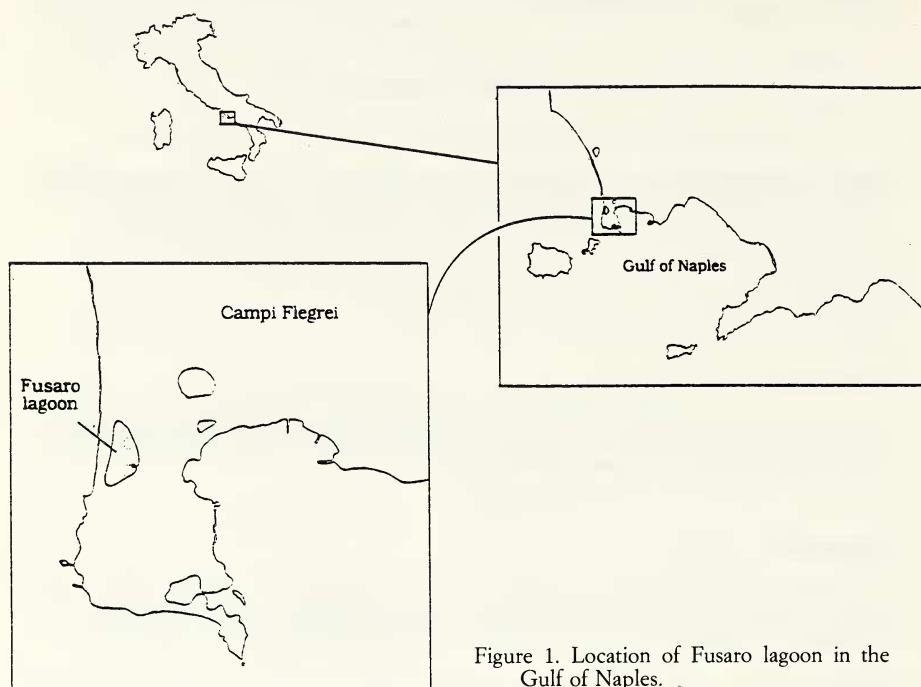


Figure 1. Location of Fusaro lagoon in the Gulf of Naples.

Water re-cycling in the lagoon is only through the tidal action and is extremely reduced owing to the almost total absence of a freshwater contribution. In a 24 h period only about 8.4% of the volume is recycled. All these factors are responsible for the hypersalinity trend in the Fusaro lake.

Muddy bottoms are dominant both in the lagoon and the channels. The lagoon lacks natural shores, but submersed walls surround the lagoon and the channels, constituting the only hard substratum found in the Fusaro, together with an artificial breakwater around Casina Vanvitelliana.

Benthic communities have been previously characterized by Russo & FERRO (1980), who found three types of faunistic associations: in hard bottoms the upper 5 cm are dominated by barnacles and mitilids, whereas the infralitoral community consists of serpulids which form a net with their calcareous tubes, which retain sand particles, constituting a microhabitat for some tunicates such as *Ciona intestinalis* and *Microcosmus sulcatus*, actinarians such as *Bunodactis verrucosa* and *Paranemonia cinerea*, the bryozoa *Bugula neritina* and the bivalves *Ostrea edulis* and *Petricola litophaga*. Soft bottoms are dominated by a bivalve community, mainly *Tapes decussatus*, *Paphia aurea* and *Cerastoderma edule* (RUSSO & FERRO, 1980); several areas are covered by *Ulva lactuca* and *Chaetomorpha aerea*, although these algae are not fixed to the bottom.

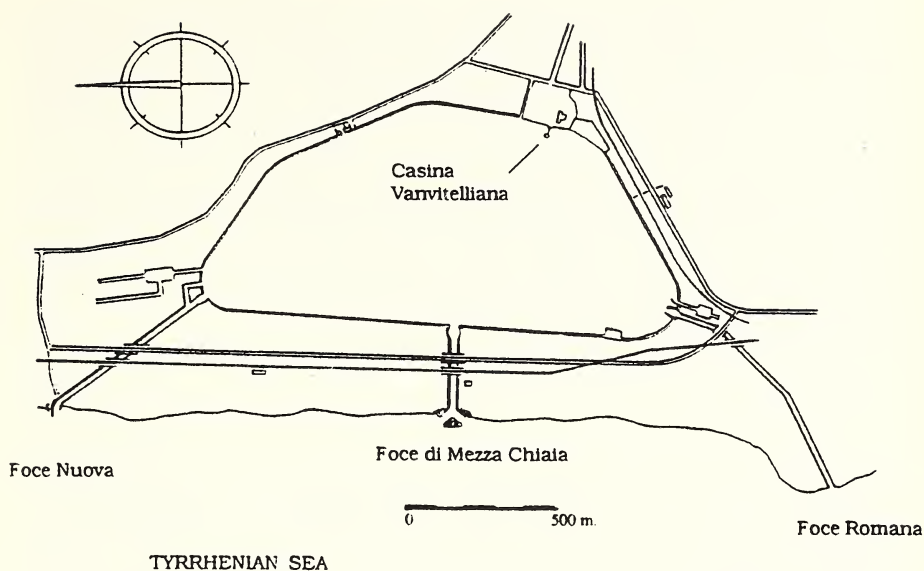


Figure 2. Map of the Fusaro lagoon, showing the location of the three «foce» and the Casina Vanvitelliana.

The malacofauna from the Fusaro has been previously studied by BELLINI (1901), MAZZARELLI (1921), FERRO & RUSSO (1981, 1982), but almost only Prosobranchs and Bivalves were reported in these works. The most important contributions concerning opisthobranch fauna are that of SCHMEKEL (1968), who found in the lagoon 13 Sacoglossa and Nudibranchia species, and the revision by CATTANEO-VIETTI & CHEMELLO (1991), with 17 species reported.

## Material and Methods

Between 1990-91, in the course of several samplings into the Fusaro lagoon in order to collect marine invertebrates for chemical studies, some observations and samplings were made about the Opisthobranch fauna, using scuba-diving techniques. Samples were taken principally on hard substrata, in the three channels and also in the breakwater surrounding the Casina Vanvitelliana, a small Borbonic pavilion built in the inner shores of the lagoon. Animals were caught by direct observations and also by means of algae washing.

## Results

A total of 25 species were found (see Table 1), only five of them scarce.

The species most abundant and more frequently recorded are the herbivores. Among them, Cephalaspidea belonging to the *Haminaea* genus make up numerically important populations. Three species can be found: *H. orbignyana*, *H. ortei* and a third, *H. fusari*, recently described by ALVAREZ *et al.* (1993). These *Haminaea* species are found in high densities, specially in spring-summer time, when the reproductive activity is highest. Our observations disagree with those of FERRO & RUSSO (1981), who only recorded one species, *Haminaea hydatis*, with a great phenotypic variation. These authors only studied the shell, whereas our experiences have shown that shell characteristics are not reliable diagnostic features as far as identifying Cephalaspidea species is concerned.

Species	Channels	Breakwater
<i>Philine aperta</i>	+	-
<i>Philinopsis depicta</i> *	+	-
<i>Bulla striata</i>	+	-
<i>Haminaea orbignyana</i>	+	+
<i>Haminaea ortei</i>	+	-
<i>Haminaea fusari</i>	+	+
<i>Akera bullata</i>	+	+
<i>Aplysia fasciata</i>	+	-
<i>Aplysia depilans</i>	+	-
<i>Aplysia punctata</i>	+	-
<i>Bursatella leachii</i>	+	-
<i>Notarchus punctatus</i> *	+	-
<i>Pleurobranchaea meckelii</i> *	+	-
<i>Elysia viridis</i>	-	+
<i>Ercolania funerea</i>	+	+
<i>Placida dendritica</i>	-	+
<i>Caliphylla mediterranea</i>	-	+
<i>Spurilla neapolitana</i>	+	+
<i>Facelina coronata</i>	+	-
<i>Facelina dubia</i>	+	-
<i>Favorinus branchialis</i>	+	-
<i>Janolus cristatus</i>	+	-
<i>Polycera quadrilineata</i>	+	+
<i>Polycera dubia</i> *	+	-
<i>Taringa sp.</i> *	+	-

Table 1. Distribution of Opisthobranch species in the two habitats sampled at the Fusaro lagoon. Those ones considered to be rare are marked with an asterisk.

An interesting and scarcely reported data is the great differences in the spawn among the *Haminaea* species. Thereby, in *H. orbignyana* it is a light yellow ribbon with eggs arranged in regular rows, the height of these rows does not vary along the ribbon. *H. orteai* shows eggs arranged also in rows, but variable in height. On the other hand, the species *H. fusari* has a bright yellow spawn; eggs are not arranged in rows but irregularly.

Another herbivorous species is *Akera bullata*, found in lower densities than *Haminaea* spp., and that spawns from May to June. The carnivorous *Philine aperta*, also inhabiting soft bottoms, is common and feeds on little bivalves.

Among the Anaspeidea, three *Aplysia* species can be found in great quantities: *A. fasciata*, *A. depilans* and *A. punctata* together with *Bursatella leachii*; the latter, now spreading into the Mediterranean Sea from the Indian Ocean, inhabits sheltered areas, such as harbours and lagoons, and thus finds an optimal habitat in the Fusaro. On the contrary, *Notarchus punctatus* is an occasional species, there.

'acoglossa is one of the most abundant group in the lagoon. Life cycles in this order are correlated to those of the algae they feed on. From January to May the cladophoral *Chaetomorpha capillaris* grows, with *Ercolania funerea* and its spawns associated with it. The caulerpal *Bryopsis plumosa* can be found from March to May, coinciding with the presence of *Placida dendritica*, which feeds on this alga together with *Caliphylla mediterranea* and *Elysia viridis*. The almost total absence of Porifera in the Fusaro lagoon is the reason why the number of Nudibranchia species is so reduced. In fact, among eudoridaceans only one *Taringa* species has been found by chance in one of the channels. The widespread species *Polycera quadrilineata* makes up important populations; animals and its spawns are found both on the bryozoa *Bugula neritina* and the sea squirt *Ciona intestinalis*. This species shows a great chromatic variation, thus specimens white in colour with scarce yellow stripes are found together with almost completely orange and black pigmented individuals. *Polycera dubia* was occasionally found in one of the channels, close to the sea.

*Facelina coronata* is one of the most abundant species in the lagoon, which reaches up to 7 cm in length and is present throughout the year, but with a maximum density from January to May. On the contrary, *Facelina dubia*, and easily-recognized species because of its smooth rinophores, is very scarce in the Fusaro.

The coloration of *Spurilla neapolitana* is darker than usual because of the fact that the Actiniaria on which it feeds in the lagoon are *Bunodactis verrucosa* and *Paraneomonia cinerea*, darker in colour than *Anemonia sulcata*, usually reported as its food. The latter is very rare in the Fusaro and is only present in the channels close to the sea.

From February and through the spring *Janolus cristatus* can be found in the lagoon, usually associated with *Bugula neritina*. This species grows up to 10 cm long in the Fusaro, and the two colour patterns (orange and blue) can be found, the former much more abundant.



## Discussion and Conclusions

A phenomenon we can observe in the Fusaro is the existence of a biotic zonation, as it often happens in very «closed» environments, such as coastal lagoons. This means that the number of Opisthobranch species increases as we reach the sea, that is, bigger in the channels area, close to the sea, than in the inner part of the basin, near Casina Vanvitelliana (see Table 1).

Table 2 shows a comparison between the number of Opisthobranch species previously found in the Fusaro and those reported in the present paper. Eleven species already collected were absent in our samples (see Table 3). As far as *Haminaea hydatis* is concerned, the identity of the species is very probably wrong, because only the shell was used as a diagnostic feature; besides it should be pointed out that no *H. hydatis* was found in our samplings despite the fact that another three *Haminaea* species, including a new one, were collected. Very probably, species such as *Limacia clavigera* and *Okenia elegans* are found accidentally, as they are not typical of lagunar environments, and the same would apply to *Taringa* sp. recorded in the present paper. The absence of species such as *Calliopaea bellula* and *Aeolidiella alderi* is more difficult to explain; both of them had been previously recorded here, and are considered as very common in brackish areas.

	Previous works	Present paper
CEPHALASPIDEA	2	7
ANASPIDEA	0	5
NOTASPIDEA	0	1
SACOGLOSSA	6	4
ARMINACEA	1	1
AEOLIDACEA	5	4
DORIDACEA	6	3
TOTAL SPECIES	20	25

Table 2. Comparison between the number of Opisthobranch species from the Fusaro reported in previous works and in the present work.

# OPISTHOBRANCHS FROM THE FUSARO LAGOON

## PRESENT PAPER

### **Cephalaspidea**

*Philine aperta*  
*Philinopsis depicta*  
*Bulla striata*<sup>c</sup>  
*Haminaea orbignyana*  
*Haminaea ortei*  
*Haminaea fusari*  
*Akera bullata*

### **Anaspidea**

*Aplysia fasciata*  
*Aplysia depilans*  
*Aplysia punctata*  
*Bursatella leachii*  
*Notarchus punctatus*

### **Notaspidea**

*Pleurobranchaea meckelii*

### **Sacoglossa**

*Elysia viridis*<sup>a</sup>  
*Ercolania funerea*<sup>a</sup>  
*Placida dendritica*<sup>a</sup>  
*Caliphylla mediterranea*

### **Nudibranchia**

*Spurilla neapolitana*<sup>a</sup>  
*Facelina coronata*  
*Facelina dubia*  
*Favorinus branchialis*<sup>a</sup>  
*Janolus cristatus*<sup>a</sup>  
*Polycera quadrilineata*<sup>a</sup>  
*Polycera dubia*<sup>a</sup>  
*Taringa sp.*

## ANOTHER SPECIES PREVIOUSLY RECORDED

*Haminaea hydatis*<sup>b</sup>

*Placida viridis*<sup>a</sup>  
*Limapontia capitata*<sup>a</sup>  
*Calliopaea bellula*<sup>a</sup>

*Aeolidiella alderi*<sup>d</sup>  
*Eubranchus exiguus*<sup>a</sup>  
*Coryphella pedata*<sup>f</sup>

*Polycera hedgpethi*<sup>e</sup>  
*Polycerella emertoni*<sup>a</sup>  
*Limacia clavigera*<sup>f</sup>  
*Okenia elegans*<sup>f</sup>

Table 3. Comparison between the species recorded in this work and in previous ones. Abbreviations: a=SCHEMEKEL, 1968; b=FERRO & RUSSO, 1981; c=FERRO & RUSSO, 1982; d=SCHEMEKEL & PORTMANN, 1982; e=CERVERA *et al.*, 1988 f=CATTANEO-VIETTI & CHEMELLO, 1991.

We have not found in our samples the species *Polycera hedgpethi*, an Indo-Pacific species first recorded in the Mediterranean Sea by CERVERA et al. (1988), on the basis of specimens from the Fusaro lagoon. This species is often found as a member of the communities inhabiting ship hulls. This could be the way this species reached the Mediterranean Sea.

Although the number of species recorded in the Fusaro may seem small (25), it is larger than that recorded from other coastal Mediterranean lagoons with similar features (see Table 4). Only the Stagnone di Marsala (Sicily) has a rich Opisthobranch population due to its special features (it extensively communicates with the sea and shows a wide range of habitats), but its specific composition is very different to that of the Fusaro: in Marsala eudoridaceans are a well represented group (CATTANEO-VIETTI & CHEMELLO, 1991). In other Mediterranean lagoons with a well known Opisthobranch fauna (Mar Menor, Sète, Orbetello...) several species have been found. It must also be born in mind that the variable knowledge on the fauna in different geographical areas could account for many of differences in the number of species recorded in Mediterranean lagoons.

To sum up, Opisthobranch fauna from the Fusaro can be considered rich in the number of species, specially if we consider the particularly adverse characteristics of the lagoon, with its quick changes of salinity, temperature and dissolved oxygen, all those features considered as limitant to the life. At this point we must consider the great pollution of this coastal lagoon, enhanced by the very slow water interchange with the sea and the high summer temperatures, and the eutrophic processes what occurs during summer time, which reduce dramatically the dissolved oxygen in the lagoon.

MEDITERRANEAN LAGOONS	N° OF SPECIES
Mar Menor (Spain)	15
Calblanque (Spain)	7
Estany des Peix (Formentera, Spain)	15
Sète (Thau, France)	18
Berre (France)	10
Orbetello (Italy)	13
Marsala (Sicily, Italy)	23
Mar Piccolo (Taranto, Italy)	8
Fusaro (Naples, Italy)	25

Table 4. Number of Opisthobranch species present in several Mediterranean lagoons (data after MARIN, 1988; DANTART *et al.*, 1990; CATTANEO-VIETTI & CHEMELLO, 1992; this work).



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